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Three primary magma types from Pagan volcano in the Mariana arc and implications for arc magma genesis

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Pagan is an active volcano located in the volcanic front of the central Island Province of the Mariana arc and is one of the largest volcanoes in the Mariana arc; its main edifice rises from a base ˜3,000 m below sea level and has a volume of 2,160 km3. Tamura et al. (2011) demonstrate the existence of near-primitive, phenocryst-poor lavas at NW Rota-1 volcano in the Mariana arc, which is located about 40 km west of the volcanic front. These magnesiana basalts are petrographically distinct cpx-olivine basalt (COB) and plagioclase-olivine basalts (POB).

The active Pagan volcano has erupted near-primitive lavas on its submarine flanks. The least fractionated compositions recovered from the NE flank (HPD1147) extend to higher MgO (7-11 wt %) and Mg# (60-70), than have ever been sampled from Pagan island lavas.

The Fo contents of olivine (up to Fo94) and Cr-number of spinels (up to 0.8) suggest that these magmas formed from high degrees of mantle melting. There are three geochemical groups of cpx-olivine basalt (COB1, COB2 and COB3) (Fig. 1). TiO2, Na2O, K2O, Rb, Nb are lowest in COB1 and highest in COB3. COB3 have steeper LREE-enriched patterns but the REE patterns of COB1 show contrasting LREE-depleted patterns, suggesting that COB1 formed from higher degrees of mantle melting. On the other hand, COB1 have the highest Ba/Th ratios and COB3 have the lowest, suggesting that a shallow subduction component is more important for COB1 than COB3, with COB2 intermediate. COB1, COB2 and COB3 show a negative trend on the Ba/Nb-Nb/Yb diagram. The higher Ba/Nb of the COB1 indicate that the COB1 contain greater abundances of slab-derived subduction components than the COB2 and COB3. Nb/Yb suggests that the degree of melting of the COB1 source is higher than for the COB2 and COB3.

Keywords: magma, arc volcano, basalt, primary magma, Mariana arc, subduction zone